IN THE SPECIFICATION

Page 1, between the title of the invention and the first line of the text, insert the following:

CROSS-REFERENCE TO RELATED APPLICATION

This Application is a Section 371 National Stage Application of International Application No. PCT/FR2004/00538, filed March 5, 2004 and published as WO 2005/029757 on March 31, 2005, not in English.

FIELD OF DISCLSOURE

Please replace the paragraphs appearing on page 1, lines 3-16 with the following amended paragraphs:

The field of the ~~invention~~ disclosure is that of wireless communications. More specifically, the ~~invention~~ disclosure relates to the reception and especially the decoding of signals received in a receiver through one or more transmission channels.

More specifically again, the ~~invention~~ disclosure relates to the iterative decoding of data encoded by means of a non-orthogonal space-time encoding matrix.

The ~~invention~~ disclosure can thus be applied especially but not exclusively to transmission systems using a plurality of antennas (at least two antennas) for emission and/or reception. Thus, the ~~invention~~ disclosure is well suited to receivers for non-orthogonal space-time codes with Nt (Nt $\geq$2) emitter antennas Nr (Nt $\geq$2) reception antennas based on MIMO (Multiple Inputs Multiple Outputs) and MISO (Multiple Inputs Single Output) systems.

An exemplary application of the ~~invention~~ disclosure lies in the field of radio communications, especially for systems of the third, fourth and following generations.

Page 1, after line 16, insert the following heading:

BACKGROUND OF THE DISCLOSURE

Please replace the paragraph appearing on page 1, lines 17-20 with the following amended paragraph:

For such systems, beyond two emitter antennas, the 1-rate space-time codes are non-orthogonal. This is the case for example with the Tirkkonen [6] and Jafarkhani [7] codes (the references cited in the present patent ~~applications~~application are brought together in appendix 1).

Page 3, after line 3, insert the following heading:

SUMMARY

Please replace the paragraphs appearing on page 3, lines 4-27 with the following amended paragraphs:

~~It is a goal of the invention to overcome the different drawbacks of the prior art.~~

~~More specifically, it is a goal of the invention to provide a technique for the decoding of space-time codes that is more efficient than prior art techniques, while at the same time showing reduced complexity.~~

~~Thus, it is a goal of the invention to provide a technique of this kind, implementing a non orthogonal space-time encoding matrix, which however does not rely on a maximum likelihood criterion.~~

~~In other words, it is a goal of the invention to provide a technique of this kind that can be implemented practically and realistically in receivers at acceptable cost, in a system implementing a large number of antennas (4, 8 or more antennas) and/or a modulation with a large number of states.~~

~~It is another goal of the invention to provide a technique of this kind that is more efficient in particular than the one proposed by Boariu, and is not limited to a particular class of codes but is, on the contrary, applicable to all block space time~~

~~codes, whatever their efficiency. Similarly, it is a goal of the invention to enable the use of matrices having a size greater than that of the space-time encoding.~~

~~These goals, as well as others that shall appear more clearly here below, are achieved by means of~~ An embodiment of the present invention is directed to a method for the decoding of a received signal comprising symbols distributed in space, time and/or frequency by means especially of a space-time or space-frequency encoding matrix, and implementing a space-time decoding step and at least one iteration (advantageously at least two iterations), each iteration comprising the following sub-steps:

Please replace the paragraph appearing on page 4, lines 4-7 with the following amended paragraph:

The approach of one or more embodiments the invention thus makes use of a diversity pre-encoding to optimize the quality of the decoding. To this end, during each of the iterations, a corresponding pre-decoding is performed, the symbols are estimated and then a pre-encoding is repeated on these estimated symbols.

Please replace the paragraph appearing on page 4, lines 12-14 with the following amended paragraph:

Thus, an embodiment of the invention can be applied to all systems implementing an OFDM, CDMA, MC-CDMA or similar technique, or again a linear pre-decoding as described in [10].

Please replace the paragraph appearing on page 4, lines 18-20 with the following amended paragraph:

The method of an embodiment of the invention may advantageously include a channel-decoding step, symmetrical with a channel-encoding step implemented at emission.

Please replace the paragraph appearing on page 6, lines 17-18 with the following amended paragraph:

~~The~~ An embodiment of invention also relates to a single-iteration system comprising only the following sub-steps:

Please replace the paragraph appearing on page 7, lines 8-9 with the following amended paragraph:

~~The~~ An embodiment of invention can also be applied to a system with only one emitter antenna. The number of reception antennas may also be variable.

Please replace the paragraph appearing on page 10, lines 2-4 with the following amended paragraph:

~~The~~ An embodiment of invention also relates to a method of encoding and decoding, according to which the encoding implements a space-time encoding matrix such as:

Please replace the paragraphs appearing on page 10, lines 8-13 with the following amended paragraphs:

~~The~~ An embodiment of invention also relates to receivers implementing decoding means that carry out the method described here above.

Other features and advantages of one or more embodiments of the invention shall appear more clearly from the following description of a preferred embodiment of the invention, given by way of a simple illustrative and non-restrictive example, and from the appended drawings ~~of which:~~.

Page 10, after line 13, insert the following heading:

BRIEF DESCRIPTION OF THE DRAWINGS

Please replace the paragraph appearing on page 11, lines 6-7 with the following amended paragraph:

- Figure 8 is a general drawing of the approach of an embodiment of the invention, implementing a linear diversity pre-encoding;

Page 11, after line 25, insert the following heading:

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Please replace the paragraph starting on page 11, line 26 and ending on page 12, line 3 with the following amended paragraph:

~~The~~ An embodiment of invention therefore proposes a novel approach to the decoding of space-time codes that is more efficient and simpler to implement. For this purpose, it proposes especially to implement, at the encoding stage, a diversity pre-encoding (by spread-spectrum or linear pre-encoding methods), and iterative processing at reception. According to the ~~invention~~embodiment, a decoding and then a re-encoding corresponding to this pre-encoding are performed at each iteration. This gives an increasingly precise estimation of the symbols emitted and provides for the increasingly efficient elimination of transmission-caused interference from the received signal.

Please replace the paragraph appearing on page 12, lines 9-14 with the following amended paragraph:

To facilitate an understanding of an embodiment of the invention, we shall first of all rapidly present the known approach of Jafarkhani (§ 1), and then the iterative approach,

without the use of a pre-encoding for a four-antenna code (§ 2), then two eight-antenna codes, respectively a known code (§ 3) and a new code (§ 4). Then we should present two examples of decoding of embodiments of the invention, respectively using a linear pre-encoding (§ 5) and a spread-spectrum encoding (§ 6).

Please replace the paragraph appearing on page 15, lines 12-14 with the following amended paragraph:

One of the aspects of an embodiment of the present invention is that it cancels out the interfering terms iteratively through *a priori* knowledge of the signal emitted. To do this, two modules are used as illustrated in figure 2:

Please replace the paragraph appearing on page 22, lines 21-23 with the following amended paragraph:

The complex symbols to be emitted are called s1, s2, s3, s4, s5, s6, s7 and s8. There are 16 emission time intervals available, IT1~~, IT2, IT3, IT4, IT5, IT6, IT7 and IT8~~ . . . IT16 during which the contributions hi are assumed to be constant.

Please replace the paragraph appearing on page 25, line 3 with the following amended paragraph:

The two steps of an embodiment of the invention are performed as follows:

Please replace the paragraph appearing on page 27, lines 6-9 with the following amended paragraph:

For such codes, an embodiment of the invention provides for simple decoding through the most efficient use of the diversity provided by the space-time code and also by the pre-encoding scheme. Figure 8 presents a (non-orthogonal) space-time encoding system associated with pre-encoding, as well as the corresponding

receiver.

Please replace the paragraph appearing on page 27, lines 23-30 with the following amended paragraph:

As illustrated in figure 9, the diagonalization step comprises first of all a diagonalization 91 proper, as described here above. It is followed by a de-interlacing operation ~~92~~, symmetrical with the interlacing operation performed at emission, and then by an inverse pre-decoding operation ~~93~~ 92 symmetrical with the pre-encoding operation performed at emission, and then by a symbol estimation ~~94~~ 93. Then, a new pre-encoding operation ~~95~~ 94, identical with the one made at emission, is performed on the estimated symbols and finally an interlacing operation ~~96~~ is performed, identical with the one performed at emission.

Please replace the paragraph appearing on page 28, lines 5-13 with the following amended paragraph:

Then, in each iteration, the operations also performed during the diagonalization step are repeated: de-interlacing ~~102~~ symmetrical with the interlacing performed at emission, inverse pre-decoding ~~103~~102, symmetrical with the pre-encoding performed at emission, then estimation of the symbols ~~104~~103. Then a new pre-encoding ~~105~~104, identical to the one performed at emission, is carried out on the estimated signals and finally an interlacing ~~105~~ is carried out, identical with the one performed at emission. The result $\bar{s}^{(p-1)}$ is reintroduced into the next iteration or, for the last iteration, taken into account for the remainder of the processing operation.

Please replace the paragraph appearing on page 28, lines 27-31 with the following amended paragraph:

The curve Ite2 shows that the approach of an embodiment of the invention takes advantage of both types of diversity: pre-

encoding and space-time codes. The resulting diversity is equal to 64*4 = 256. This is quasi-Gaussian diversity for a spectral efficiency of 2 bits/Hz. For further gain in diversity, it is possible to use one of the two eight-antenna codes presented here above.

Please replace the paragraph appearing on page 30, lines 5-8 with the following amended paragraph:

The MRC (Maximum Ratio Combining) filtering technique is combined with the approach of an embodiment of the invention implementing an equalization (in this case of the MMSE or Minimum Mean Square Error type). This latter approach gives far better results.

Please replace the paragraph appearing on page 32, lines 12-14 with the following amended paragraph:

According to another aspect of an embodiment of the invention, the symbols can be encoded by means of a channel-encoding operation and then pre-encoded. A space-time encoding is then performed.

Please replace the paragraph appearing on page 35, lines 18-19 with the following amended paragraph:

According to these different aspects, one or more embodiments of the invention ~~has~~have numerous advantages, such as:

Please replace the paragraph appearing on page 35, lines 28-30 with the following amended paragraph:

The efficiency of the method of an embodiment of the invention can be further improved by implementing automatic gain control (AGC) before or after said equalization step and/or

during said iterations.

Please add the following paragraphs on page 35, after line 30:

One or more embodiments of the invention overcome the different drawbacks of the prior art.

More specifically, one or more embodiments of the invention provide a technique for the decoding of space-time codes that is more efficient than prior art techniques, while at the same time showing reduced complexity.

Thus, one or more embodiments of the invention provide a technique of this kind, implementing a non-orthogonal space-time encoding matrix, which however does not rely on a maximum likelihood criterion.

In other words, one or more embodiments of the invention provide a technique of this kind that can be implemented practically and realistically in receivers at acceptable cost, in a system implementing a large number of antennas (4, 8 or more antennas) and/or a modulation with a large number of states.

One or more embodiments of the invention provide a technique of this kind that is more efficient in particular than the one proposed by Boariu, and is not limited to a particular class of codes but is, on the contrary, applicable to all block space-time codes, whatever their efficiency. Similarly, one or more embodiments of the invention enable the use of matrices having a size greater than that of the space-time encoding.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.